Draft Submittal

" File Copy "

Addendum
Treatment of Richard Mine Acid Mine Drainage
Contract # RM-MON-1
Alternatives Report

for the
West Virginia Conservation Agency
Monongahela Conservation District
and
Natural Resources Conservation Service

Prepared by:
GAI Consultants, Inc.
500 Summers Street, 3rd Floor
Charleston, West Virginia 25301

Project E050451.10.09

December 2008

gai consultants

Table of Contents

List of Tables

List of Figures

1.0 Introduction

This report is presented as an addendum to the report entitled, "Treatment of Richard Mine Drainage, Contract #RM-MON-1, Alternatives Report" Revised September 2007 by GAI Consultants, Inc. The original report assessed the feasibility of a multitude of treatment alternatives for the Richard Mine Acid Mine Drainage (AMD). Following the completion of the report, the West Virginia Department of Environmental Protection, in the summer of 2008, offered to provide operation and maintenance of an active treatment system involving sludge injection back to the mine.

This offer changed the dynamic of the original report, as no entity had previously been identified to conduct the day to day operation and maintenance for an active treatment system. Based on the changed condition of a new partner to provide operation and maintenance, the alternatives of active treatment and sludge disposal are being reanalyzed. The operation and maintenance cost and no identified agency to perform the operation and maintenance were major disadvantages of active treatment in the previous report. This disadvantage being minimized, the active treatment of the mine discharge is considered to be an alternative comparable to the top recommendation discussed in the previous report.

In this report, a more detailed discussion is provided of an active treatment system combined with sludge being disposed by injecting it back into the mine workings.

2.0 Facility Location

The Richard Mine discharge is located on the southern end of the mine network. It discharges by gravity through a mine wet seal consisting of one primary 18-inch diameter pipe and a backup 12-inch diameter pipe. The discharge elevation is approximately 945 feet. A schematic of the extraction, active treatment, sludge transmission and sludge injection is shown on Figure 1.

Three different scenarios, as shown on Figure 2, are considered in the pumping of mine water and sludge related to the treatment of the Richard Mine AMD discharge. It is the intent of this report to cover primary options for withdrawal and treatment of the AMD. There are several sub-options or combination of options due to the large footprint of the mine and quantity of water involved. That being said, the options considered in this report include:

- Scenario #1 -Water withdrawal and treatment near the natural outlet of the mine. Sludge will then be pumped to a proposed injection well location on the western edge of the Richard Mine footprint. Two different injection locations are considered.

- Scenario #2 - Water withdrawal near the outlet of the mine. This untreated water will then be pumped to a treatment system located toward the center of the Richard Mine footprint to the north. After treatment, the sludge from this treatment system will then be pumped to an adjacent injection well(s).

- Scenario #3 - Water withdrawal utilizing deep well pumps from directly above the mine pool on the southeastern end of the footprint then piped to an adjacent treatment plant. The sludge will then be pumped to a proposed injection well location on the northern to central portion of the Richard Mine footprint. Two different extraction and treatment facility locations (#3A and #3B) are identified.

2.1 Scenario #1

Scenario #1 was considered for several reasons:

- The immediate benefit determined for this option is that the water withdrawal structure and treatment plant remain in a relatively industrial area away from residential populations. This will help to minimize disturbance to residential areas that have not been directly impacted by Richard Mine in the past. This site also allows for construction, operation and maintenance to occur within several hundred feet of a primary state route (WV Route 7).

- The site keeps water withdrawal and treated water discharge near the same location as it has historically discharged. Therefore, there is no discontinuity in the base flow of Deckers Creek.

- The site allows for the pumping of raw mine water with very little vertical elevation to overcome. The treatment plant will be located within 40 feet vertically of the withdrawal location so water extraction pumps can be relatively low horsepower.

- This scenario minimizes total piping length. This assists in lowering the initial capital costs and minimizes pipe maintenance costs with regard to cleaning and upkeep.

- Depth of the injection boreholes will be 250 feet or less in depth comparing the structural contours of the Freeport Seam to the surface elevation.

- Minimal underground utility conflicts are anticipated.

Scenario #1 is **dismissed** as the preferred scenario for the following primary reasons:

- The relatively flat property located to the east of the current discharge is very near the floodplain of Deckers Creek. Review of the flood mapping for this area indicates that the 100 year flood elevation is 948 feet near the bridge accessing the property. Scaling the map, the elevation of the 100 year flood at the current discharge location is 945 feet approximately the same as the elevation of the Richard Mine discharge.

- The property at this location is anticipated to be difficult to obtain. While the owner of the property containing the actual discharge point has been very courteous in allowing access to the site for research purposes, obtaining permanent easements may be difficult.

- Due to the height of the sludge column in this pipeline, proper design for both pressure and vacuum conditions in pumping will be critical.

- Obtaining right-of-way for this length of line will involve crossing private land near a residential subdivision. Based on a review of the tax maps, right-of-way from at least 5 private landowners will be required.

- There is potential for the sludge to immediately flow to the natural mine outlet (short circuiting). The straight line distance from injection site #1A is 3,000 feet to the outlet and the distance from injection site #1B is 4,000 feet to the outlet.

- The flow of sludge away from the injection point will be minimized as sludge injection will occur in the mine workings above the mine pool. Thus, utilizing the excess alkalinity of the sludge to neutralize the mine pool will not occur.

- Draw down of the mine pool will be limited as there is minimal grade drop in the accessible portion of the mine at this location.

2.2 Scenario #2

Scenario #2 is considered for several reasons. Just as with Scenario #1, the primary benefits include the water withdrawal being performed at the natural outlet of the mine and this facility being in close proximity to WV Route 7. Additional benefits include:

- The disturbance footprint to the land is minimized with this concept as only shallow extraction wells or a submersible pump system would be required for the removal of water. As such, negotiation of land acquisition and right-of-ways are anticipated to be easier due to the minimized impacts to surrounding land.

- The force main primarily follows WVDOH right-of-way to the proposed treatment plant and injection point. As such land negotiations with private citizens will be limited to the area immediately around the discharge and at the final destination.

- The treatment plant being positioned adjacent to the proposed sludge injection point minimizes sludge pumping with regard to both length and elevation difference.

- Most importantly, the treated water from this scenario is discharged into an unnamed tributary of Tibbs Run which enters Deckers Creek upstream of the current Richard Mine discharge. As such, there will be no significant change in the base flow of Deckers Creek since the treated water will be discharged upstream.

Scenario #2 is d**ismissed** as the preferred scenario for the following reasons:

- This scenario requires the greatest length of force main piping (compared to Scenario's #1 and #3) and the greatest single pump stage change in elevation. The AMD force main will be almost 13,500 feet (2.5 miles) in length and climb approximately 300 feet in elevation. This will increase initial capital costs and long term operation and maintenance costs.

- The treatment plant will be located over the Richard Mine workings. As such, the potential for subsidence will need to be evaluated for a structure of this size and cost.

- The AMD force main will require several air/vacuum release valves along its length. The internal pumping turbulence inside the main will mix the air introduced at these locations into the AMD. The AMD from the Richard Mine pool is oxygen starved and begins to precipitate iron oxide almost immediately after discharge. This is evident on the flow monitoring flume located just 30 feet downstream of the discharge which has required substantial cleaning on a monthly basis. It is anticipated that the force main will require similar monthly (or more frequent) cleaning to subdue iron oxide deposits.

- The raw water force main will encounter a multitude of underground utilities, utility poles, driveway crossings and businesses along its length. It will pass through the community of Dellslow and Pioneer Rocks on the way to the treatment plant location.

2.3 Scenario #3

After considering the various and most readily identifiable options available for treatment of the Richard Mine AMD, Scenario #3 appears to have the greatest promise for the efficient treatment of the water contained in the Richard Mine. Figure 3 details the Scenario #3A on aerial photographs.

The primary benefits of Scenario #3 include:

- The treatment plant can be located to avoid the footprint of the Richard Mine workings (Scenario #3A) so subsidence potential is minimized.

- The project will add a base flow to an unnamed tributary of Deckers Creek for approximately 5,000 feet until its confluence with Deckers Creek.

- The water extraction system is adjacent to the proposed treatment plant which will minimize pumping time and length. This will first of all minimize the introduction of air that will in turn minimize the amount of iron oxide generated prior to the water entering the treatment system.

- The need for negotiating any type of land purchase or permanent right-of-way at the natural outlet of the Richard Mine is eliminated.

- The extraction wells will be located over deeper sections of the Richard Mine allowing more of the mine pool to be drawn down than can be accomplished with either Scenarios 1 or 2. Comparing the estimated discharge elevation of 945 feet to the structural contours of the Freeport Seam, the extraction wells can be installed to an elevation between 800 feet and 850 feet allowing approximately 100 to 150 feet of the pool to eventually be drawn down. This will provide extended storage for AMD should pumps go down or electricity be lost. Based on available geologic contour data, this will also eliminate the natural discharge at the current location along Deckers Creek.

- Sludge is injected sufficiently upstream of the extraction wells to minimize the potential for short circuiting within the mine. The straight line distance is over 7,000 feet. The sludge injection will occur within the mine pool. The excess alkalinity of the sludge will assist in the neutralization of the mine pool.

The primary challenges associated with Scenario #3 include:

- The proposed treated water discharge location will be to a perennial unnamed tributary of Deckers Creek that empties approximately 8,300 feet downstream of the natural outlet of the Richard Mine. This will reduce the base flow of water in Deckers Creek within that reach of stream.

- The proposed location(s) shown for the extraction wells and treatment system are relatively close to the unincorporated community of Brookhaven.

- The sludge from the treatment plant will require pumping to the injection location. The injection site is located approximately 9,500 feet away within the right-of-way of WV Routes 7/21 and 68/1. While the injection site is only 200 to 250 feet in elevation higher than the treatment plant, WV Route 7/21 has a crest along it that is over 310 feet above the treatment plant. The force main route can possibly be reduced to around 7,000 feet in length but will require property negotiation with 6 to 12 private landowners and will still have to be pumped over a crest over 300 feet higher in elevation than the treatment plant.

- Water extraction pumps will be expensive and require special engineering due to their extended length from the surface to the mine.

Scenario #3 is the recommended approach for the treatment location. Scenario #3A, near the intersection of WV Routes 7/22 and 68/1, will be discussed in detail for the treatment process in this report.

3.0 Water Collection / Extraction Wells

The average flow from the discharge has historically been presumed to be on the order of an average of approximately 300 gpm with a maximum discharge of approximately 800 gpm. While data is still incomplete for the current monitoring of discharge from the Richard Mine, as of the date of this report, the 11 month basic average for 2008 is 415 gpm with a maximum flow of approximately 650 gpm. The system is proposed to be designed to treat a maximum of 800 gpm so that the mine pool can be lowered and the original discharge point of the mine will be minimized or eliminated.

Based on the conceptual approach shown on Figure 2, the pumps will be located at a surface elevation of approximately 1200 feet. This location will result in the mine being drilled into at an elevation of approximately 820 feet for a total depth of 380 feet. This depth will require specially designed pump systems as this is not a typical pumping situation. Over the past year the flow rate recorded out of the Richard Mine varied from a peak of 650 gallons per minute (gpm) to a low of around 150 gpm. The setup discussed will be sizing the pumps so one can keep up with the yearly average flow rate. The second pump will then allow for additional capacity to lower the mine pool or handle peak discharges identified in the winter months. Reduction of the mine pool will accomplish the primary goal of eliminating the direct discharge of acid mine drainage directly into Deckers Creek and will create reserve capacity so in the event of multiple pump failures or a power outage, a storage buffer will be available without the mine discharging to Deckers Creek.

The proposed water extraction system for the Richard Mine pool will consist of two 400 gpm simplex vertical multi-staged (12) pumps with an adjustable speed drive. The system considered is the Goulds DWT-FFTM 6x9RCLC 12 stage pumps. The pump has 313 stainless steel bowl construction with a 6-inch diameter stainless steel discharge. The stainless steel discharge will be constructed in 20 sections that would be attached and lowered into the vertical hole. The motor will be a 75 hp USEM VHS inverter duty motor and run off three phase 460 volt power. The pumps will be controlled with a Toshiba AS14550AAN3 outdoor packaged pump control with an adjustable speed drive. The electrical components and motor are mounted at the surface which will allow for simple maintenance. The electrical components will be located at the surface.

The purpose of this control will be to keep a constant load on the pumps without shutting them down entirely. The adjustable speed control will be varied as needed to keep water flowing to the treatment plant at a constant rate based upon the time of year and anticipated infiltration into the mine. The two pump system will allow up to 800 gpm to be pumped at the beginning of the project to lower the mine pool or handle peak flows identified during the past year (typically during winter months). During other times of the year as infiltration reduces the mine pool can be lowered more rapidly based upon budgeted treatment costs. In the event a pump will have to be taken out of service, it will still leave one pump to keep up with base flow.

Two 12-inch diameter boreholes will be drilled at a location at or near that shown on Figure 2. An engineered concrete pad will be necessary at the surface to accept a 16.5-inch base flange installed at the top of the stainless steel pump sections. It will be necessary to install a relatively straight bore hole to allow for a snug fit with minimal tolerance on the sides. However, slight bends in this type of pump system tend to cause uneven wear in the bearings.

The adjustable speed motors are chosen to allow the pumps to run continuously. Unlike hydropneumatic pumps, which tend to be cycled on and off, these pumps are made to run constantly. Alternating starts and stops is difficult on this particular style of equipment due to its length and for lubrication of the bearings. Two versions of lubrication are available. First is simple water lubrication from the pumped water itself. Rubber bearings on the outside of the shaft can be used and potable water can be fed down the hole at startup to minimize wear until the water reaches the surface. However, the proposed option will be an oil drip system where food grade oil is dripped down the center of the pump shaft to lubricate internal brass bearings. The amount of oil used is minimal but eventually does make it to the bottom of the pump where it would enter the Richard Mine pool.

An approximate volume of the mine pool that exists within the Richard Mine was estimated. As discussed in previous reports, the geologic contours of the Freeport Coal Seam dip to the northwest in the vicinity of the Richard Mine. Approximate contours of the coal seam are generated from the original WV Geologic Survey mapping for Monongalia County. The highest floor elevations of the Richard Mine exist along the eastern edge of the mine at elevation +/- 1400 feet. The geology dips to the northwest at an approximate slope of 10% to a minimum mine elevation estimated at 780 feet.

The mine has a gross footprint area of approximately 1900 acres or 2.96 square miles. Based on the estimated discharge elevation of 945 feet and the geologic contours, the mine pool covers a gross area of approximately 800 acres or 1.25 square miles. Therefore the mine pool inundates approximately 42% of the mine footprint.

The Freeport seam has a reported average thickness of six feet within this area. The mine mapping did not indicate that the pillars were robbed during retreat from the Richard Mine so an estimate of coal removal efficiency for the Richard Mine is made at 50%. As such, the mine would theoretically hold the following volume of water;

800 ac. X 6 feet seam depth X 50% coal removal = 2,400 acre feet or 781,989,120 gallons

Based on the geologic contours of the Freeport seam the mine pool ranges in elevation from 945 feet down to an estimated bottom elevation of 780 feet. As such, the estimated volume of mine pool per foot of depth assuming a constant mine pool length is expressed as follows;

781,989,120 gallons /165 feet = 4,739,328 gal/ft. (general average)

Assuming the extraction pumps are set up to have an excess pumping rate of 100 gallons per minute over the base inflow from infiltration, the mine pool would be dropped by 1 foot (on general average) every;

4,739,328 gal. per ft. / 100 gal. per min. = 47,393 min/ft = 790 hours/ft = 32.9 days/ft

Please note that the footprint of the mine is not a constant shape and narrows from its maximum length near its crest at elevation 945 feet to approximately half the original width at elevation 780 feet. As such, the higher elevations of the mine pool (elevations 850 to 945 feet) are estimated to contain a larger portion of the mine pool volume. Assuming up to a 50% variation in drawdown time would result in the mine pool being drawn down one foot every 17 to 48 days at a rate of 100 gpm depending on the elevation of the mine pool. Pumping rates could be increased or decreased with the equipment specified to adjust this withdrawal rate and associated mine pool draw down time.

4.0 Water Treatment System

The following portion of this report will discuss active treatment and sludge generation for injection back into the mine working. Based on the water quality parameters of the discharge, a proposed treatment system utilizing hydrated lime was developed. GAI worked with N.A. Water Systems of Moon Township, Pennsylvania to create a conceptual design of an active treatment system.

The design basis for the treatment system is derived from the historical monitoring data summarized in GAI's previous reports. The following table presents a summary of the historic monitoring data.

Parameter	Minimum	Average	Maximum
Flow, gpm*	100	300	800
pH, s.u.	2.9	3.8	4.3
Acidity, mg/l as $CaCO_3$	595	907	1,297
Iron, mg/l	96	171	233
Manganese, mg/l	2.7	4	10.2
Aluminum, mg/l	46	68	95

*Flow monitoring date obtained through November 2008 occur within this range.

The flows in the above table are rounded to the nearest hundred for design purposes. The historic flow data shows a high degree of variability. The average flows are significantly lower between 1997 and 2000 as compared to the flows from 2001 to 2006. The flows may be influenced by the time of year that readings were measured or from the by the measuring method. GAI is currently completing a study to compare discharge versus precipitation at the main discharge outlet for Richard Mine for 2008. This data will be incorporated into the final design of any treatment system.

For the purposes of the conceptual design, the peak flow from the table above of 800 gpm was used to size the proposed treatment process. One sample in the historic data was tested for sulfate which showed a value of 1,280 mg/l. Based on this sulfate level, it is assumed that the calcium sulfate solubility limit of approximately 2,400 mg/l will not be exceeded in the treatment process. If the solubility limit is exceeded, calcium sulfate will precipitate creating higher sludge volumes.

Figure 4 presents a process flow diagram of the proposed system. Figure 5 shows a general layout of the system. Figure 6 shows a layout of the treatment system for Scenario #3A. A preliminary equipment list showing the major components of the treatment process is shown in Table 1.

The raw AMD will be pumped from extraction wells into a pre-aeration tank to strip carbon dioxide and reduce acidity. This step is typically beneficial when treating AMD water to reduce lime consumption. The tank will be equipped with a mechanical slow-speed surface aerator. The pre-aeration tank will be constructed of concrete with a working volume of 16,000 gallons, providing 20 minutes of retention at a peak flow of 800 gpm.

The over flow from the pre-aeration tank will enter the ferrous oxide tank. This tank would have a common wall construction with the pre-aeration tank. The ferrous iron oxide tank will have a working volume of 24,000 gallons, providing 30 minutes retention time at peak flow. The tank will be equipped with a slow-speed surface aerator to provide oxygen for converting ferrous iron to ferric iron. Lime slurry is blended with recycled sludge from the clarifier in a conditioning (Alkalization) tank, which then flows into the ferrous oxide tank to neutralize the AMD water. This process promotes the growth of dense metal oxide crystals rather than voluminous metal hydroxide floc particles.

Lime will be supplied from a 50-ton hydrated lime silo and feed system. The lime consumption is estimated at approximately 1.3 ton per day at an average flow of 300 gpm and 3.5 ton per day at the peak flow. The estimates are based on the average acidity and metals concentrations in the AMD water. The lime silo will provide about two weeks supply at the peak flow.

The overflow from the ferrous oxide tank will flow into a 50-foot diameter flocculating clarifier/thickener for solids separation. A polymeric flocculant will be added to the clarifier inlet to enhance sedimentation. Sludge is continuously recycled from the clarifier back to the sludge conditioning tank. Waste sludge will be pumped from the clarifier to an injection point and back into the abandoned mine workings.

The amount of sludge formed from this treatment process is estimated to be 1,600 pounds per day (dry solids). The expected volume of sludge to be pumped to the injection borehole will average approximately 1,000 gallons per day. The sludge will be pumped intermittently based on the level of sludge in the clarifier.

The treated water from the clarifier will be discharged into a polishing (settling) pond. The polishing pond will provide additional settling time for fine particles prior to discharge. The polishing pond will also serve as a source of utility water for the treatment plant for lime dilution and sludge line flushing. The polishing pond will discharge into the unnamed tributary of Deckers Creek as shown on Figure 2.

5.0 Water Quality Discharge

The expected clarifier effluent is shown in the table below along with the WVDEP Water Quality Standards for the parameters of concern. The Water Quality Standards below may not necessarily apply to the AMD discharge into Deckers Creek, but are presented for comparison to the expected treatment system effluent. The Water Quality Standards will be the targeted water quality benchmark for the treatment process.

Parameter	Expected Clarifier Effluent Quality	WVDEP Water Quality Standards
pH, s.u.	7.5 – 8.5	6 – 9
Iron, mg/l (total)	<1	1.5
Iron, mg/l (dissolved)	<0.10	NA
Manganese, mg/l (total)	<1	1.0
Aluminum, mg/l (total)	<1.5	NA
Aluminum, mg/l (dissolved)	<0.50*	0.087

* With the exception of dissolved aluminum, the treatment system is expected to achieve the WVDEP Water Quality Standards. Based on similar treatment plant experience, it will be difficult to guarantee compliance with a dissolved aluminum criteria of 0.087 mg/l. Dissolved aluminum should consistently be reduced to less than 0.5 mg/l if the treatment system pH is maintained in the 7.5 to 8.0 range. Particulate aluminum can typically be reduced to less than 1.5 mg/l using the proposed treatment system. The proposed polishing pond will provide additional settling time for fine aluminum particles above and beyond the clarifier.

The polishing pond will be discharging into a nearby unnamed tributary of Deckers Creek. The discharge point where the polishing pond will be located has a 482 acre watershed and the 1 year storm event is 28 cfs or 13,000 gpm. The entire drainage area covers 734 acres and the 1 year storm event is 36 cfs or 16,000 gpm. The treatment plant will be adding an additional base flow of approximately 300 gpm. This is an increase of 2.3% at the polishing pond discharge point and an increase of 1.9% for the entire drainage area.

6.0 Handling and Disposal

After treatment, the generated sludge will be reintroduced into the upper portions of the Richard Mine workings at a higher elevation. This location is shown on Figure 2. WV Routes 7/21 and 68/1 are located in close vicinity to the proposed extraction wells and treatment system. The best location will be to install the sludge line in the right-of-way for WV Routes 7/21 and 68/1 to an intersection approximately 8,800 feet northeast with WV Route 68/7. The sludge line would exit the WVDOH right-of-way and cross private land for approximately 800 feet to the proposed sludge injection location.

The transmission system necessary to move the sludge from the treatment plant to the injection location will be provided using a 3-inch diameter SDR II Butt-fused HDPE. Force main "pigging" cleanouts will be provided every 1,000 feet (maximum). Progressive-cavity pumps will be used to convey the sludge. In order to minimize the potential for line plugging, there will be a water flush cycle at the end of each sludge pumping cycle to clear the pipeline. The pipeline will also be equipped with pig launching and receiving stations to clean the pipeline.

A progressive-cavity pump system will be utilized for the sludge. This style pump transfers fluid by means of progress, using a sequence of small, fixed shape, discrete cavities, as its rotor is turned. This leads to the volumetric flow rate being proportional to the rotation rate and to low levels of shearing being applied to the pumped fluid. The cavities taper down toward their ends and overlap with their neighbors, so that, in general, no flow pulsing is caused by the arrival of cavities at the outlet, other than that caused by compression of the fluid or pump components.

Specific designs involve the rotor of the pump being made of steel, coated in a smooth hard surface, normally chromium, with the body (the stator) made of a molded elastomer inside a metal tube body. The elastomer core of the stator forms the required complex cavities. The rotor is held against the inside surface of the stator by angled link arms, bearings (which have to be within the fluid) allowing it to roll around the inner surface (un-driven). Elastomer is used for the stator to simplify the creation of the complex internal shape, created by means of casting, and also improves the quality and longevity of the seals by progressively swelling due to absorption of water and other common constituents of pumped fluids.

Pigging has been used for many years in the pipeline industry. Pigging doesn't usually interrupt the process or flow of liquids, though some product can be lost when the pig is extracted. Pigs are used for a cleaning and sealing utility pipelines. Pigs are divided into several classes; mandrel pigs, foam pigs, solid cast pigs, and spherical pigs. The type of pig to be selected depends on the use. There are also several specialty pigs for specific uses. The pig required for use of the slurry line will be a simple cleaning pig. Special fittings will need to be located on the slurry line to launch and receive the pig. These fitting will be placed within subsurface structures. It is estimated that the lines will need to be pigged twice a month.

The sludge disposal will initially consist of drilling two 8-inch diameter boreholes to the mine workings. The sludge will be injected into the most upgradient boring by gravity until there is no more take. At that time, the injection will move to the other boring. A series of smaller diameter monitoring wells will be placed around the injection site to monitor movement of the injected slurry.

Based on the conceptual approach shown on Figure 2, the top of the injection wells would be located at a surface elevation of approximately 1350 feet. This location would result in the mine being drilled into at an elevation of approximately 950 feet for a total depth of 400 feet.

7.0 Permit Requirements

As a result of the unique aspects of this project regarding construction and ultimate operation and maintenance, permitting requirements were discussed with each regulatory entity. The WVDEP Abandoned Mine Land Program typically does not require WVDEP Water Resource permits as they are part of the same agency. The Richard Mine is different in that the West Virginia Conservation Agency and Natural Resources Conservation Service will be constructing the project while the WVDEP will be performing on-going operations and maintenance. Based on research to date, the following permit processes are anticipated for implementation of the Richard Mine Treatment Facility.

U.S. Army Corps Of Engineers—Clean Water Act Sec. 404(b)(1) Permit

The Secretary of the Army, acting through the Chief of Engineers, is authorized to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into waters of the United States at specified disposal sites. Selection of such sites must be in accordance with guidelines developed by the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army; these guidelines are known as the 404(b)(1) Guidelines.

The anticipated Corp permit is either a general "Nationwide" 12 or 14 permit for common stream and water impacts below a specified level of disturbance. The preferred scenario shown will limit impact to a discharge structure for the treatment plant and perpendicular crossings of ephemeral and intermittent streams. This project will also result in substantial improvement to the quality of Deckers Creek which will tend to offset the minor impacts of construction. In the event an "Individual" permit is required by the Corp, additional steps are necessary.

Processing such permits involves evaluation of individual, project specific applications in what can be considered three steps: pre-application consultation, formal project review, and decision making.

Pre-application consultation usually involves one or several meetings between an applicant, Corps district staff, interested resource agencies (Federal, state, or local), and sometimes the interested public.

Once a complete application is received, the formal review process begins. The project manager prepares a public notice, evaluates the impacts of the project and all comments received, negotiates necessary modifications of the project if required, and drafts or oversees drafting of appropriate documentation to support a recommended permit decision. The permit decision document includes a discussion of the environmental impacts of the project, the findings of the public interest review process, and any special evaluation required by the type of activity.

Current trends are 45 to 75 days for a "Nationwide" Permit and 120 to 180 days for an "Individual" permit.

401 Water Quality Certification

Section 401 Water Quality Certification is required for each permit or license issued by a federal agency to ensure that proposed projects will not violate the state's water quality standards or stream designated uses. States are authorized to issue Certification under Section 401 of the Federal Clean Water Act. Applicants must receive State 401 Water Quality Certification before they can receive a permit from the federal agency.

This application must be completed whenever a proposed activity requires a Clean Water Act Section 401 Individual State Water Quality Certification from the West Virginia Department of Environmental Protection (WVDEP). A Section 401 Certification from the State is required to obtain a Federal Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers, or any other federal permits or licenses for projects that will result in a discharge into any waters of the State.

In order for the WVDEP to issue a Section 401 Certification, the project must comply with the State Water Quality Standards (46 CSR 1) and not potentially result in an adverse long-term or short-term impact on water quality.

General Construction Storm Water Permit

The WV NPDES Storm Water program requires operators of construction sites one acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge storm water under an NPDES construction storm water permit. The purpose of this permit is to provide coverage for any discharges composed entirely of storm water associated with industrial or construction activity. The WVDEP has developed the General WV/NPDES Water Pollution Control Permit to regulate sediment laden storm water flowing into the waters of the State from discharges associated with construction activities.

Mr. Bill Timmermeyer, an Environmental Recourses Project Manager for the WVDEP's Division of Water and Waste Management supplied us with information regarding storm water permitting. Mr. Timmermeyer indicated that the site would first need to be registered, and then a general construction permit would need to be completed and returned to the WVDEP along with a Storm Water Pollution Prevention Plan.

Additionally, Groundwater Protection Plans (GPPs) are required for all facilities having the potential to impact groundwater. They are "preventive maintenance" documents that cover all processes and materials at a facility that "may reasonably be expected" to have an effect on groundwater quality. The facility must make an inventory of all potentially contaminating processes and materials, and have structures and practices in place to prevent groundwater contamination from these processes and materials. Groundwater protection practices include, at a minimum, quarterly inspections and maintenance by facility personnel and usually include spill cleanup procedures. Mr. Timmermeyer added that, once the construction contractor has been selected, a GPP will need to be developed and kept on site in the case of an emergency or audit. The GPP is no longer required as a section in the storm water permit package.

When the construction activity is completed and all disturbed areas are stabilized, a Notice of Termination (NOT) must be submitted in order to end coverage under the General Permit.

Underground Injection Control Permit

The Underground Injection Control (UIC) program is designed to ensure that fluids injected underground will not endanger drinking water sources. The WVDEP Division of Water and Waste Management regulate Class 5 wells. These wells include agriculture drainage wells, improved sinkholes, industrial disposal wells, storm water wells, coal mine backfill injection, and septic systems that have the capacity to serve 20 or more people.

Mr. Timmermeyer indicated that an Underground Injection Permit will need to be obtained for the Richard Mine Treatment Facility. Mr. Yogesh Patel, Engineering Chief of the WVDEP NPDES Team was also contacted on this matter, he added that the UIC Class 5 can be permitted one of two ways; if the sludge is not treated before injection, then a UIC Class 5X13 is required. Class 5X13 stipulates that the sludge injected must satisfy secondary drinking water quality standards set forth by the USEPA and the WVDEP. Alternatively, if the sludge is treated a Class 5X26 is required. This stipulates that certain parameters must be set and wells be monitored accordingly to remain in compliance with secondary drinking water quality standards.

Individual/Industrial NPDES Permit

The individual WV/NPDES permit process takes up to one year to complete, and includes the development and advertisement of a Draft Permit, and opportunity for the public to comment and to request a public hearing. The Industrial NPDES Permit is for the installation, operation and maintenance of a disposal system or part thereof, for the direct discharge of industrial wastes into waters of the State. The individual Permit may regulate the discharge of toxic and/or conventional pollutants associated with the discharge. Compliance with the more stringent of technology-based and water quality-based effluent limitations are required. The Permit will also contain requirements designed to protect and improve groundwater. The aforementioned Groundwater Pollution Prevention Plan (GPP) must be prepared for all industrial facilities.

Mr. Patel explained that before the permit can be processed there must be 6 months of data collected from a downstream point of Deckers Creek selected by the WVDEP. Once the data is collected and analyzed, parameters would be set in order to comply with effluent discharge limitations. Once the permit and all required data have been processed, a draft permit would be written and submitted for public comment. This process can take anywhere up to 6 months.

Ms. Julie Wandling, WVDEP Environmental Resources Specialist with the Division of Water and Waste Management was contacted in regards to whether or not a waste load analysis is needed for the discharge anticipated at the treatment facility. According to Ms. Wandling the only instance where this would be necessary is if there is some source of oxygen depletion, such as some source of nutrients discharge. Ms. Wandling indicated that this probably would not be the case at the Richard Mine but certain limitations may be put on the discharge once a water pollutant analysis has been completed.

Additionally, Mr. Timmermeyer indicated that a Leachability Analysis must be performed as part of the WVDEP NPDES permitting process set forth by the USEPA. Once sludge production has begun, a sample of the sludge must be analyzed for hazardous contaminates. This process is called the Toxic Characteristic Leaching Procedure (TCLP). Results are then compared to the

TCLP D-list maximum contamination levels. Sludge creation and disposal will need to be re-addressed with the WVDEP if TCLP results come back too high.

West Virginia Division of Natural Resources "Land & Stream Activity" Application

Ms. Amy Hammock of the West Virginia Department of Natural Resources (WVDNR) was contacted in regards to any possible conflict that the WVDNR might have with this treatment facility. Ms. Hammock indicated that a Land & Stream Activity Form is required so that the WVDNR can review the proposed site activities and keep the form on file as a reference only. This process should only take around three weeks.

West Virginia Department of Highways "MM-109" Permit

Because a portion of the pipeline carrying the sludge will be constructed parallel within the West Virginia Division of Highways (WVDOH) right-of-way, an MM-109 Permit is required. The MM-109 states that any work or construction within WVDOH right-of-way is subject to the approval of State Road Commissioner. Due to the length of work within the WVDOH right-of-way, scenarios for maintenance of traffic will need to be specified. Since work will be under a state and federal agency contract, the project most likely will not require an individual bond for the WVDOH right-of-way work; however, it will be necessary to have the general contractor building the project under a standard performance and payment bond to cover any damages caused to WVDOH property.

8.0 Cost Analysis

8.1 Initial Capital Costs

The estimated capital cost for construction of Scenario #3A is summarized in Table 2. The capital cost does not include permitting fees, right-of-way acquisition, engineering, and construction management fees. For the purpose of this cost analysis, the costs are subdivided into five main categories. They are Demolition, Sitework and Utilities, Treatment Plant, Pumping Systems and Contractor Costs. The Demolition Cost was added in the event clearing of the site would be needed. The conceptual site is relatively open and no other structures currently occupy the area. Sitework includes utilities, any construction on site not including the buildings and pumping, the wells for extraction and injection, and any pre-cast or other structures needed for storage. The treatment plant is priced to include the water treatment process. The Pumping systems costs include prices on all pumps needed for extraction and injection as well as the service lines needed to convey the materials to and from the treatment plant including any damages incurred during this construction. The Contractor Costs are costs that will be incurred during the construction process. There was also a 5% contingency added to the final pricing to account for unanticipated conditions that may occur during the construction process.

The estimated "in ground" construction cost based on the preceding qualifications is $3.25 million.

This cost estimate is preliminary in nature and shall be used as a guideline for initial budgeting purposes only. These estimates are not intended to be used as a final construction estimate.

8.2 Operation and Maintenance

The annual operation and maintenance costs (O&M) were estimated based on anticipated usage of electrical power, chemicals, equipment maintenance, and operator labor. Chemical costs are based on commodity pricing. The following table presents a summary of the estimated annual O&M costs:

Item	Units	Unit Cost	Quantity	Annual Cost
Operator Labor(1)	Hr	$50.00	40 hr/week	$104,000
Transmission Line Pigging(2)	Day	$800	24	$19,200
Miscellaneous(3)	LS	LS	1	$20,000
Electricity	kW-hr	$0.08	90 kW	$62,000
Hydrated Lime	Ton	$110.00	9.3 ton/week	$53,000
Polymer	Lb	$2.00	14 lb/week	$1,500
Equipment Maintenance	LS	LS	1	$20,000
Polishing Pond Cleaning	LS	LS	1	$20,000
			Total Estimated Annual O&M Cost	**$299,700.00**

(1)This cost assumes that a full time Class 2 treatment plant operator will be required to maintain the system. Cost includes salary, benefits, on-call backup operator for sick/vacation days and agency administration time associated with the plant.

(2)It is assumed that pigging of the lines will require two days per month of a line cleaning subcontractor.

(3)Miscellaneous costs would include general utilities, snow removal, office supplies, etc.

The annual O&M costs presented above are generally higher than those presented in the previous Alternative report. The main reasons for the higher costs are the inclusion of the electrical power cost and operator cost.

9.0 Summary

Based on the discussion presented in this addendum report, the order of the top five treatment alternatives is revised from the original report to as follows:

1. Hydrated Lime with Mechanical Mixing and Sludge Injection into Mine Workings
2. Conveying Drainage to Larger Water Body
3. Lime Dispensing Doser with Settling Pond
4. Gas Injection of Anhydrous Ammonia; and
5. Activated Iron Solids.

Scenario #3A is recommended as the location for treatment of the Richard mine pool. This method and approach provides a method to potentially eliminate the discharge into Deckers Creek at Richard by pumping down the mine pool. By pumping the mine pool a constant flow of the mine drainage can be treated with increased capacity in times of higher flows. The discharge of the treated water into a tributary of Deckers Creek will return base flow to Deckers Creek fairly close to the current discharge location minimizing effects on Deckers Creek. The treatment facilities can be located in areas which are in close proximity to WVDOH right-of-way minimizing the private property required for the project. Private property will be required for the extraction well, treatment plant, and injection well locations. Preliminary locations (scenario #3A) for these facilities are shown on the Figure 2. The injection of the waste material into the mine workings will result in reduced disposal costs for the sludge. The excess alkalinity within the sludge will also provide some neutralization to the mine pool.

Additional recommendations:

- Additional information will be needed for the detailed design of the preferred alternative. An evaluation of the extent and quantity of the mine pool needs to be performed. The evaluation will consist of drilling a number monitoring wells into the mine working (approximately 1 per every 100 acres). The monitoring wells will be monitored for depth to the surface of the water. In addition, samples of the mine pool will be collected for analytical testing. The monitoring well locations as well as the mine workings map will be correlated to provide an estimate to the elevation and quantity of water within the mine pool.

- Other geotechnical investigations will be to determine the locations of the extraction and injection sites are within void areas of the mine working. Geotechnical borings will be extended to the mine workings. It is recommended that the WVDEP request the borehole camera from the U.S. Office of Surface Mine to video the proposed borings at these locations. Other standard geotechnical investigations will need to be performed for the treatment plant appurtenances and for the sludge line.

- We recommend that the flow and precipitation monitoring program already in progress continue with regard to flow rate and precipitation until the treatment process has been designed. In addition to this monitoring, a grab sample should be collected monthly. The sample should be tested in a laboratory for pH, acidity, total iron, total manganese, aluminum and sulfates. This information will be extremely helpful in the final design of the treatment process.

Tables

Table 1
Richard Mine
Dense Sludge AMD Treatment System
Functional Equipment List

Item No.		Description	Electrical			
			V/Ph/Hz	Connect HP	Oper HP	QTY
Process Equipment						
B1001	Pre-Aeration Tank Aerator	Slow-speed surface aerator, 20HP	480/3/60	20	20	1
B1002	Ferrous Oxidation Tank Aerator	Slow-speed surface aerator, 20HP	480/3/60	20	20	1
U1001	Hydrated Line Silo Package	50-ton tank, bin activator, feeder, slurry tank, and pumps	480/3/60	5	5	1
U1002	Liquid Polymer Feed System	0.05 to 0.10 gal/hr neat polymer feed	115/1/60			1
C1001	Thickener	50" dia x 12' mechanism and steel tank	480/3/60	1.5	1.5	1
Mixers						
M1001	Sludge Tank Mixer	Beam-Mount, FRP or 316SS Shaft 2HP	480/3/60	2	2	1
Pumps						
P1001 A/B/C	AMD Feed Pumps	300 gpm @ 50' tch, vertical sump pumps	480/3/60	15	7.5	3
P1002 A/B	Sludge Waste Pump	30 gpm @ 300" tch, prog. Cavity	480/3/60	10	5	2
P1003 A/B	Sludge Recycle Pump	20 gpm @ 75" tdh, horiz slurry	480/3/60	2	1	2
P1004 A/B	Utility Water Pumps	50 gpm @ 100" tdh, submersible	480/3/60	4	2	2
P1005 A/B	Building Sump Pumps	50 gpm @ 50" tdh, submersible	480/3/60	2	1	2
Tanks						
T1001	Pre-Aeration Tank	16,000 gal 12' x 12' x 18' ss, concrete				1
T1002	Ferrous Oxidation Tank	24,000 gal, 14' x 14' x 18' ss, concrete				1
T1003	Sludge Conditioning Tank	1,500 gal, 6' dia x 8' ss, steel, open top, dish bottom				1
T1004	RAW AMD Sump	12' L x 8' X 8' D, concrete				1
Concrete						
	Thickener Foundation	40' dia sloped foundation with grout				1
Piping						
	Pig Launcher/Receiver	3" Pipe Size				1
	Process Piping within Battery Limits					lot
Instrumentation						
	pH Probes	AIT/AIC				2
	Level Probes	LIT/LIC				3
	Flow Meter	4" Mag Meter				1
	Density Meter	AIT/AIC				1
	Remote PLC w Ethernet	AB CompactLogix with Ethernet Interface				1
Electrical						
	MCC, conduit/cable, lighting, grounding					lot
Equipment and Control Building						
	Pre-Engineering Building	40" L x 36" W				lot
		TOTALS		**82**	**65**	

TABLE 2

BUDGETARY OPINION OF PROBABLE CONSTRUCTION CAPITAL COSTS
Richard Mine Treatment System Scenario #3A
Morgantown, West Virginia
Prepared by:
GAI Consultants Inc. - December 19, 2008

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	EXTENSION	TOTAL
1	**Demolition:**					
a	*Miscellaneous Demolition*		LS	$5,000.00	$5,000.00	$5,000
2	**Sitework & Utilities:**					
a	*Electrical/Telephone Service*		LS	$10,000.00	$10,000.00	
b	*Water Service*		LS	$10,000.00	$10,000.00	
c	*Sanitary Service*		LS	$10,000.00	$10,000.00	
d	*General Grading*		LS	$20,000.00	$20,000.00	
e	*Polishing Pond*		LS	$50,000.00	$50,000.00	
f	*Chain Link Fencing 6'*	1,400	LF	$20.00	$28,000.00	
g	*Injection Well Drilling (8" Boreholes)*	2,400	EA	$20.00	$48,000.00	
h	*Extraction Well Drilling (12" Boreholes)*	1,200	LF	$25.00	$30,000.00	
i	*Paving*	15,000	SF	$3.00	$45,000.00	
j	*Pre-Cast Storage Structures*	2	EA	$20,000.00	$40,000.00	$291,000
3	**Treatment Plants:**					
a	*Building (40'x60')*		LS	$170,000.00	$170,000.00	
b	*Clarifier (50' Diameter) & Equipment*		LS	$395,000.00	$395,000.00	
c	*Pre-Aeration Tank*		LS	$70,000.00	$70,000.00	
d	*Ferris Oxidation Tank*		LS	$70,000.00	$70,000.00	
e	*Hydrated Lime Silo*		LS	$220,000.00	$220,000.00	
f	*Miscellaneous Amenities*		LS	$65,000.00	$65,000.00	
g	*General Construction*		LS	$980,000.00	$980,000.00	$1,970,000
4	**Pumping Systems:**					
a	*AMD Feed Pumps (Mine Water Pumps)*	2	EA	$170,000.00	$340,000.00	
b	*Waste Sludge Pumps*	4	EA	$12,000.00	$48,000.00	
c	*HDPE Force Main (3")*	10,600	LF	$15.00	$159,000.00	
d	*PVC SDR 21 (6")*	1,100	LF	$30.00	$33,000.00	
e	*Miscellaneous Utility Crossings, Driveway, and Shoulder Repairs*		LS	$20,000.00	$20,000.00	$600,000
	SUBTOTAL IN GROUND HARD COSTS					$2,866,000
5	***Mobilization (3.0%)***		LS	$85,980.00	$85,980.00	
6	***Bonding and Insurance (1%)***		LS	$28,660.00	$28,660.00	
7	***Erosion & Sediment Control***		LS	$71,650.00	$71,650.00	
8	***Maintenance of Traffic (1.5%)***		LS	$42,990.00	$42,990.00	$229,280
	SUBTOTAL					$3,095,280
	CONTINGENCY (5%)		LS	$154,764.00	$154,764.00	$154,764
	TOTAL PROJECT COSTS					$3,250,044

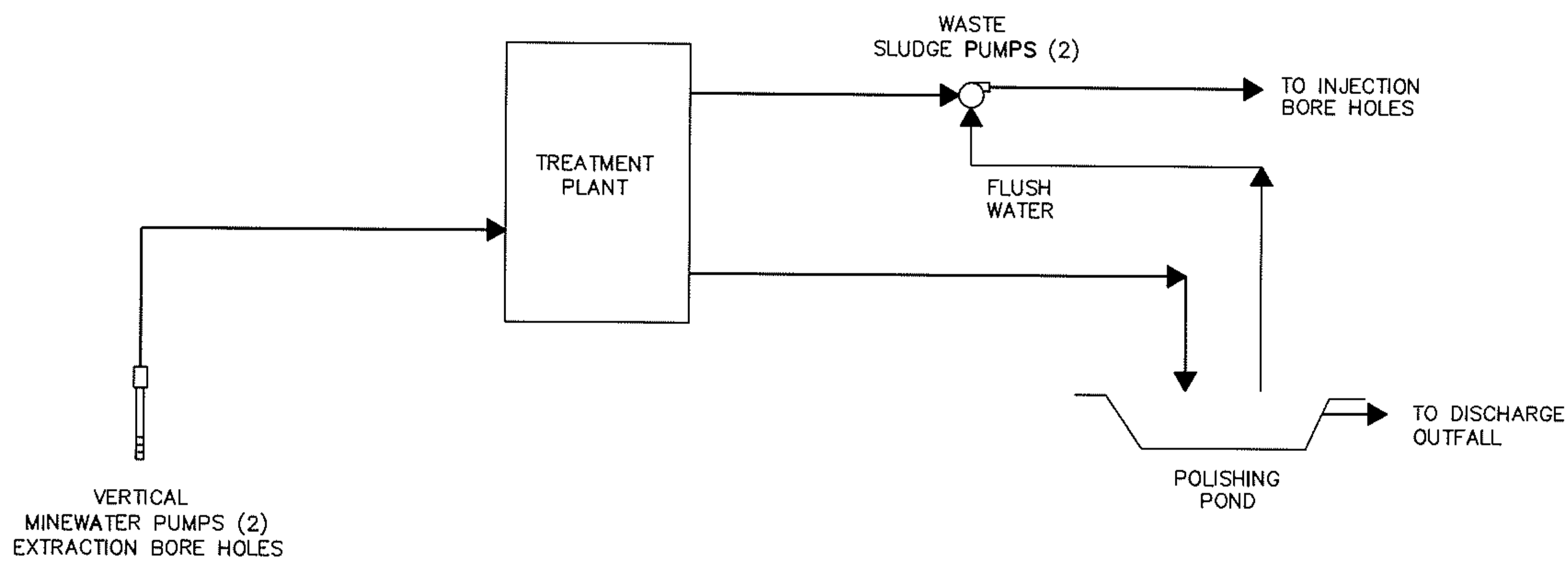
This cost opinion is preliminary in nature and shall be used as a guideline for initial budgeting purposes only. This estimate is not intended to be used as a final construction estimate.

Note: It is recognized that neither the Owner, Architect or Engineer has control over the cost of labor, materials, equipment, or construction bidding methods. Accordingly, the Engineer cannot and does not warrant that bids will not vary from this Estimate.

gai consultants

Figures

Note: Figures 2, 3, & 6 are large maps of 30" x 42"

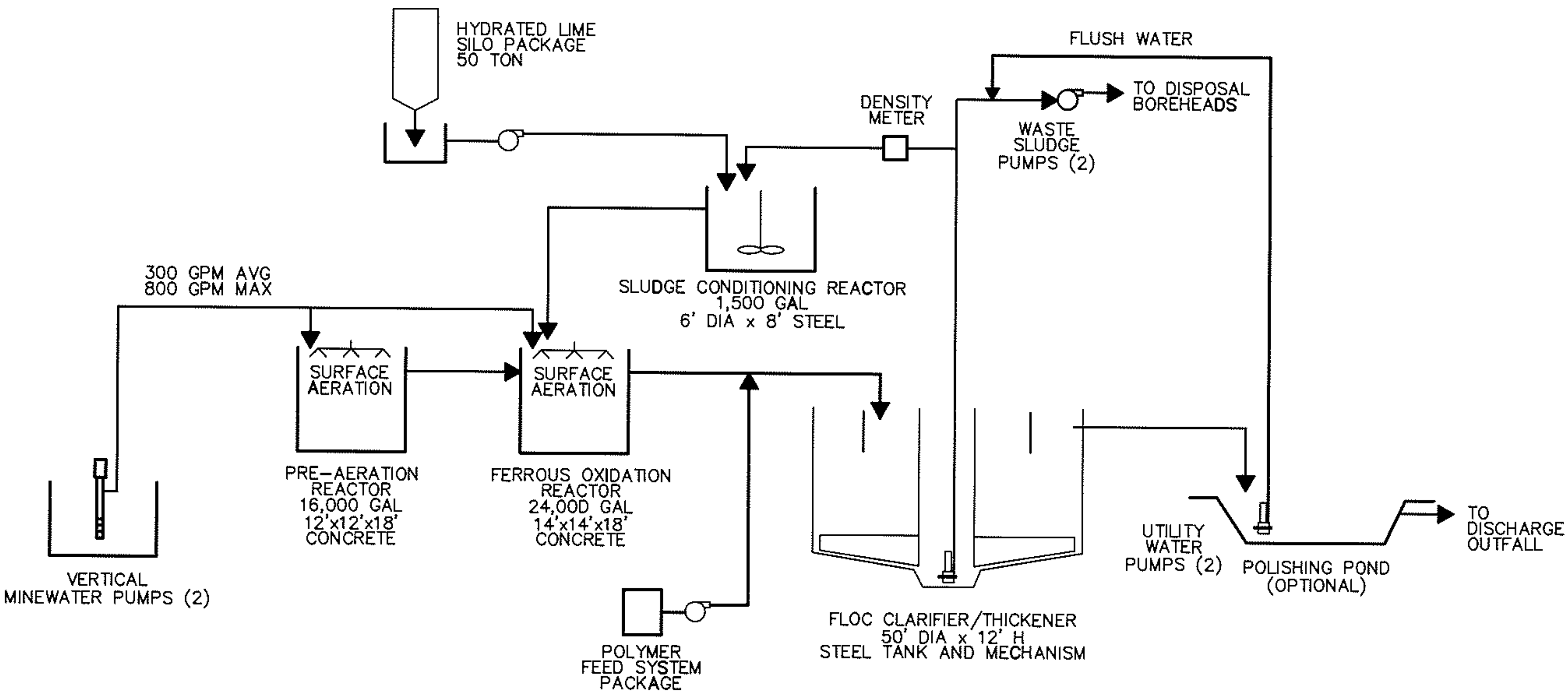


RICHARD MINE
ACTIVE TREATMENT PROCESS

N.T.S.

gai consultants

FIGURE 1

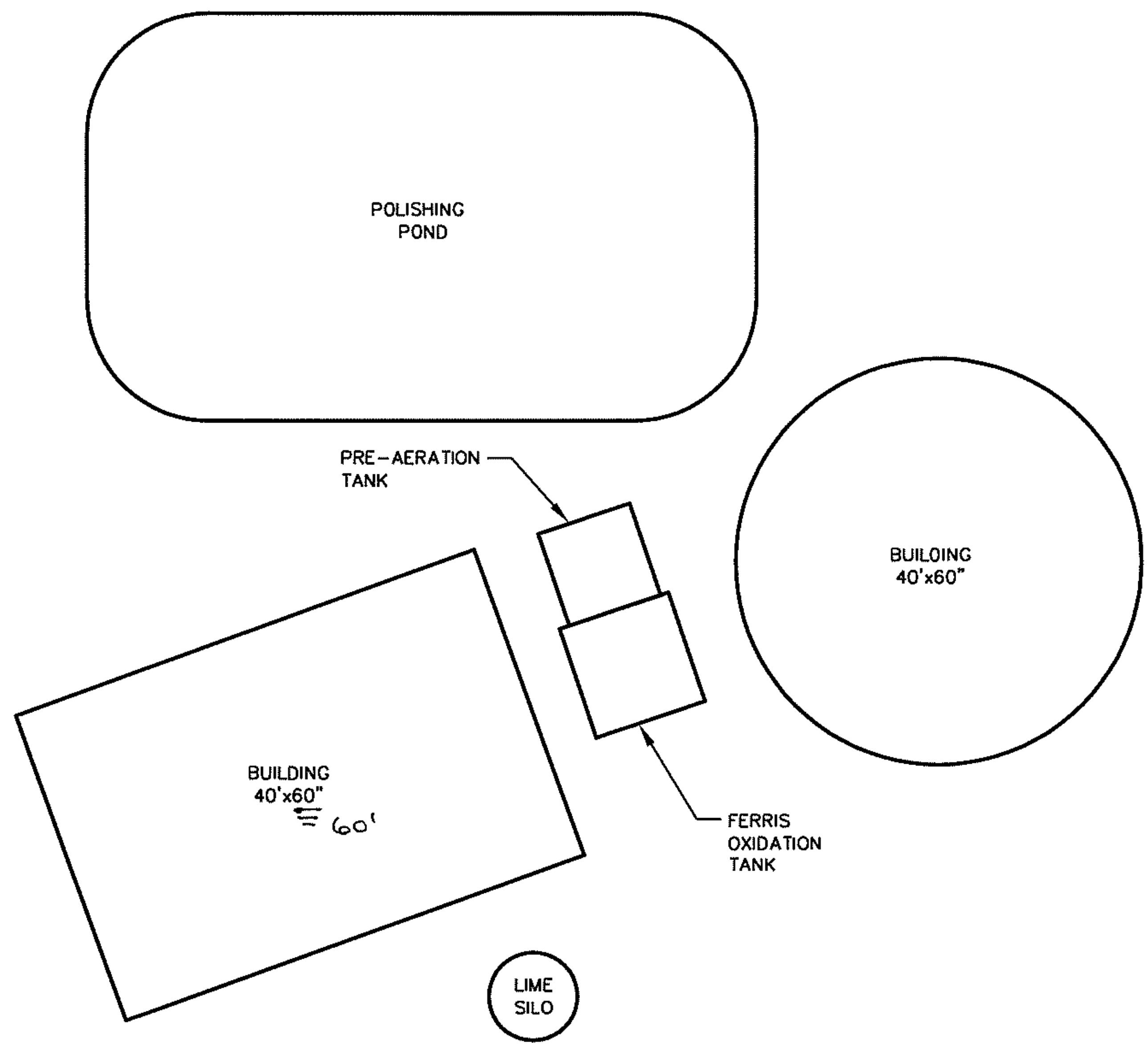


RICHARD MINE
WATER TREATMENT
FLOW DIAGRAM

N.T.S.

gai consultants

FIGURE 4



RICHARD MINE
WATER TREATMENT
SCHEMATIC LAYOUT PLAN

N.T.S.

gai consultants

FIGURE 5